In the Claims:

1. (original) An apparatus for measurement of remaining semiconductor substrate thickness of at least a portion of a semiconductor wafer, said portion having a thickness less than 50 micrometers, said measurement having an accuracy at least as good as about 100 nm, said apparatus comprising:

a holder for holding said wafer portion;

a light source of broadband emission including wavelengths from visible to IR spectrum;

a spectrometer configured to operate at light wavelengths in the range between 700 nm and 1000 nm;

a lens assembly to collimate light from said light source into a collimated light beam;

a microscope objective lens assembly positioned to focus said collimated light beam onto said wafer portion as incident light at a point of incidence, a portion of said incident light being reflected from said wafer portion, said incident light having a beam spot size at said point of incidence, said microscope objective lens assembly configured to operate in Near InfraRed (NIR) range;

means for delivering said light from said light source to said lens assembly to be collimated into said collimated light beam;

means for delivering reflected light from said wafer portion to said spectrometer;

said lens assembly and said microscope lens assembly configured to provide said beam spot size with a diameter less than 100 microns;

an xyz stage assembly, said xyz stage assembly adjustable to provide relative motion between said wafer portion and said microscope lens assembly, to

move said point of incidence across said wafer portion, to provide focus adjustment for said objective lens assembly and to provide device navigation; and

a computer in communication with said reflectance spectrometer for calculating the remaining thickness of said wafer portion.

2. (original) The apparatus of claim 1, wherein said semiconductor substrate is a silicon substrate and said semiconductor wafer is a silicon wafer.

3. (original) The apparatus of claim 1, wherein said light source of broad band emission is a regulated tungsten halogen light source.

4. (original) The apparatus of claim 1, wherein said lens assembly comprises a condenser lens assembly.

5. (original) The apparatus of claim 1, wherein said means for delivering said light from said light source to said lens assembly is a fiber optic cable coupled to said light source.

6. (original) The apparatus of claim 1, wherein said means for delivering reflected light from said wafer portion to said spectrometer is a fiber optic cable.

7. (original) The apparatus of claim 1, wherein said xyz stage assembly is configured to have said wafer portion mounted thereon.

8. (original) The apparatus of claim 1, wherein said xyz stage assembly has a resolution at least as accurate as 0.1 micron.

9. (previously presented) A method of measuring the remaining substrate thickness of at least a portion of a semiconductor wafer comprising the steps of:

mounting said wafer portion on the holder of an apparatus comprising;

1) a holder for holding said wafer portion;

2) a light source of broadband emission including wavelengths from visible to IR spectrum;

3) a spectrometer configured to operate at light wavelengths in the range between 700 nm and 1000 nm;

4) a lens assembly to collimate light from said light source into a collimated light beam;

5) a microscope objective lens assembly positioned to focus said collimated light beam onto said wafer portion as incident light at a point of incidence, a portion of said incident light being reflected from said wafer portion, said incident light having a beam spot size at said point of incidence, said microscope objective lens assembly configured to operate in Near InfraRed (NIR) range;

6) means for delivering said light from said light source to said lens assembly to be collimated into said collimated light beam;

7) means for delivering reflected light from said wafer portion to said spectrometer;

8) said lens assembly and said microscope lens assembly configured to provide said beam spot size with a diameter less than 100 microns;

9) an xyz stage assembly, said xyz stage assembly adjustable to provide relative motion between said wafer portion and said microscope lens assembly, to move said point of incidence across said wafer portion, to provide focus adjustment for said objective lens assembly and to provide device navigation; and

10) a computer in communication with said reflectance spectrometer for calculating the remaining thickness of said wafer portion;

directing incoming light from said light source into said lens assembly, said light from said light source having a broad wavelength range;

focusing said light onto said wafer portion at a point of incidence with said microscope lens assembly, a portion of said light being reflected from said wafer portion;

directing reflected light from said wafer portion into said reflectance spectrometer;

measuring the intensity of said reflected light as a function of the wavelength of said reflected light with said reflectance spectrometer to provide intensity vs. wavelength data to said computer; and

calculating said remaining substrate thickness at said point of incidence from said intensity vs. wavelength data with said computer.

10. (original) The method of claim 9, wherein said semiconductor wafer is a silicon wafer.

11. (original) A method of measuring the remaining substrate thickness within a FIB milled region of a semiconductor wafer portion comprising the steps of:

providing a wafer portion having a FIB milled region therein, and measuring the remaining substrate thickness within said FIB milled region using the method of claim 9.

12. (original) The method of claim 11, further including the steps of:

mounting said wafer portion in a FIB system having a focused ion beam;

milling a region in said wafer portion with said focused ion beam; and

removing said wafer portion from said FIB system for said mounting of said wafer portion into said apparatus.

13. (original) A method of measuring the remaining substrate thickness within a laser milled region of a semiconductor wafer portion comprising the steps of:

providing a wafer portion having a laser milled region therein; and

measuring the remaining substrate thickness within said laser milled region using the method of claim 9.

14. (original) The method of claim 13, further including the steps of:

mounting said wafer portion in a laser milling system having a laser;

milling a region in said wafer portion with said laser; and

removing said wafer portion from said laser milling system for said mounting of said wafer portion into said apparatus.

15. (original) A method of measuring the remaining substrate thickness within a rotary tool milled region of a semiconductor wafer portion comprising the steps of:

providing a wafer portion having a polished rotary tool milled region therein; and

measuring the remaining substrate thickness within said rotary tool milled region using the method of claim 9.

16. (original) The method of claim 15, further including the steps of:

mounting said wafer portion in a rotary tool milling system having a rotary tool;

milling a region in said wafer portion with said rotary tool;

polishing said rotary tool milled region; and

before or after said polishing step, removing said wafer portion from said rotary tool milling system for said mounting of said wafer portion into said apparatus.

17. (original) The method of claim 16, wherein said step of mounting said wafer portion in a rotary tool milling system includes mounting said wafer portion on a base and mounting said base in said rotary tool milling system; and

wherein said step of removing said wafer portion from said rotary tool milling system includes removing said base with said wafer portion mounted thereon.

18. (original) The method of claim 17, wherein said base is a lapping puck.

19. (cancelled)

20. (previously presented) A method of forming a thickness map of the remaining thickness of a semiconductor wafer portion comprising the steps of:

providing said wafer portion having a mirror polished surface;

providing an optical tool selected from the group consisting of: a reflectance spectrometer, a confocal microscope, and an ellipsometer;

mounting said wafer portion on a viewing stage positioned for measuring said wafer portion by said optical tool;

measuring the thickness of said wafer portion with said optical tool at at least five locations on said wafer portion, a first said location being near the center of said wafer portion, one of the at least four remaining said locations being near each of the four corners of said wafer portion; and

determining the thickness difference between said center and each of said at least four remaining locations, and determining thickness uniformity across said wafer portion from these at least five measurements.

21. (previously presented) A method of forming a thickness map of the remaining thickness of a semiconductor wafer portion comprising the steps of:

providing said wafer portion having a mirror polished surface;

providing an optical tool selected from the group consisting of: a reflectance spectrometer, a confocal microscope, and an ellipsometer;

mounting said wafer portion on a viewing stage positioned for measuring said wafer portion by said optical tool;

measuring the thickness of said wafer portion with said optical tool at at least five locations on said wafer portion, a first said location being near the center of said wafer portion, one of the at least four remaining said locations being near each of the four corners of said wafer portion;

determining the thickness difference between said center and each of said at least four remaining locations, and determining thickness uniformity across said wafer portion from these at least five measurements; and

calculating the differences in thickness between the smallest measured thickness of said at least five locations on said wafer portion and the thicknesses of each of the at least four remaining locations on said wafer portion, and, based on these calculated thickness differences, determining the amount of wafer thickness which must be removed across the wafer portion to achieve a uniform thickness across said wafer portion.

22. (previously presented) A method of forming a thickness map of the remaining thickness of a semiconductor wafer portion comprising the steps of:

providing said wafer portion having a mirror polished surface;

providing an optical tool selected from the group consisting of: a reflectance spectrometer, a confocal microscope, and an ellipsometer;

mounting said wafer portion on a viewing stage positioned for measuring said wafer portion by said optical tool, wherein said wafer portion is mounted on a lapping puck, said wafer portion and said lapping puck together being mounted on said viewing stage; and

measuring the thickness of said wafer portion with said optical tool at at least five locations on said wafer portion, a first said location being near the center of said wafer portion, one of the at least four remaining said locations being near each of the four corners of said wafer portion.

23. (original) The method of claim 22, further including the step of determining if the wafer portion is levelly mounted on said lapping puck.

24. (original) A method for mounting a semiconductor wafer portion having a top surface and a back surface onto a lapping puck to achieve uniform lapping of said top surface by a lapping platen opposing said lapping puck, comprising the steps of:

a) mounting said wafer portion onto said lapping puck by bonding said back surface to said lapping puck;

b) measuring the height of said lapping puck plus said package plus said wafer portion at about the center of said wafer portion and at about the four corners of said wafer portion and determining the height difference between said

center and each of said four corners, said height difference being the height at the corner subtracted from the height at the center;

c) determining at which of said four corners said height difference is positive and greater than 10 microns, each of said four corners having a height difference greater than 10 microns being a low corner;

d) removing said mounted wafer portion from said lapping puck;

e) remounting said wafer portion onto said lapping puck with a shim having a height equal to the height difference at a specified low corner positioned between said specified low corner and said lapping puck; and

f) repeating steps b)-e) until no low corners remain.

25. (original) The method of claim 24, wherein step b) is performed with a micrometer.

26. (original) A method of providing a uniform thickness to a thinned semiconductor wafer portion comprising the steps of:

a) providing said wafer portion having a mirror polished surface;

b) providing an optical tool selected from the group consisting of: a reflectance spectrometer, a confocal microscope, and an ellipsometer;

c) mounting said wafer portion on a viewing stage positioned for measuring said wafer portion by said optical tool;

d) measuring the thickness of said wafer portion with said optical tool at at least five locations on said wafer portion, a first said location being near the center of said wafer portion, one of the at least four remaining said locations being near each of the four corners of said wafer portion;

e) determining the thickness difference between said center and each of said at least four remaining locations, thereby determining thickness uniformity across said wafer portion and locating local thick regions of said wafer portion;

f) thinning said local thick regions of said wafer portion; and

g) repeating steps d) – f) until said wafer portion has substantially uniform thickness.

27. (original) The method of claim 26, wherein said step of thinning said local thick regions of said wafer portion comprises abrading said local thick regions with diamond paste.

28. (original) The method of claim 27, wherein said abrading of said local thick regions with diamond paste is done manually.

29. (cancelled)